

# Impact Assessment of the Single Use E-Commerce Packaging Waste Management System in Romania

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Over the last decade, e-commerce or on-line commerce has faced a significant market expansion among European Union countries, being accentuated by the COVID-19 pandemic (in 2019) and consumers' preferences for online shopping. However aside the increase turnover for the enterprises and customer satisfaction, one problem that arises is associated with increased single use packaging quantities for various products like food, beverages, e-commerce and household care products that turn into waste. With 2019 as reference year, Romania is a case in which the e-commerce has seen significant expansions of 7.2% in 2020 and 1.4% in 2021, as well as an increase of the packaging quantities of 6.3% (2020) and 17.5% (2021) (Eurostat database, 2024).

Single use e-commerce packaging waste (SEPW) quantities in Romania over 2019-2021 were calculated based on total packaging waste generated in each year (Deloitte, 2022) and its weight contribution to the packaging waste stream (Zero Waste Europe, 2022). The determined SEPW material composition is: 87.61% cardboard shipping boxes, 9.95% paper envelopes, plastic cover periodicals 1.57% and plastic shipping bags 0.87% (Zero Waste Europe, 2022). In Romania, cardboard and paper packaging waste, have registered recycling rates of 70.07%, 68.06% and 66% while plastic packaging waste have reached recycling rates of 46.79%, 46.07% and 42.32% for 2019, 2020 and 2021. Similarly, incineration rates have been 3%, 3.82% and 3.63% for cardboard and paper and 9.24, 10.79% and 10.27% for plastic waste in 2019, 2020 and 2021 (Deloitte, 2022). In this study, the remaining quantities of wastes are considered to be landfilled.

Once the SEPW quantities and composition were established, as well as the treatment methods flows were analysed, the e-commerce waste management system impact could be calculated by using US EPA WARM v15.2 methodology. This methodology employs aggregated factors associated to the main waste treatment options (material recycling for recyclable waste, composting and anaerobic digestion for biodegradable waste, energy recycling-combustion and landfilling) to quantify the environmental, social and economic impact of a specific waste system.

The main results obtained are sustainability profiles in which the environmental impact is calculated either as greenhouse gas emissions (tons CO<sub>2</sub>e) and/or as energy impact (GJ), the social impact is determined as number of full time jobs, and economic indicators are quantified as monetary flows (wages and taxes, expressed in US dollars). Each impact is calculated per material type and treatment option. The environmental impact (for both the indicators) can be estimated for the End of life treatment options or the coupled Production and End of life treatment options, while the social and economic indicators are correlated only to the End of life treatment options.

In terms of Environmental impacts, the results presented in Figure 1 a) show the total greenhouse gas emissions of production and end of life stages increase over the investigated period from 2.9 x10<sup>5</sup> tons CO<sub>2</sub>e in 2019 to 3.54 x10<sup>5</sup> tons CO<sub>2</sub>e. The same observation could be made in the case of the Energy Impact indicator, as

seen in Figure 1b) with an increase from  $1.2 \times 10^6$  GJ to  $1.46 \times 10^6$  GJ. The increased Environmental impact is justified by the increase in single use e-commerce waste quantities, with 2020 and 2021 being years in which on-line commerce have registered unprecedented increase due to COVID-19 pandemic isolation (restrictions) policies and customer preferences shifting towards on-line shopping.

Concerning the social and economic indicators, the results show the variation profiles in strict correlation with the End of life treatment options applied to e-commerce waste (Figure 1 c) and d)). The increase in waste quantities have a more significant impact on the End of life stage results, like in the case of the social indicator- Number of full time jobs 240 in 2019, 252 in 2020 and 267 in 2021. In terms of Economic impact indicators, Wages and Taxes follow the same increase tendency with the maximum results registered in 2021, 16 million USD in wages and 4 million USD in taxes connected to the End of life treatment of e-commerce waste.

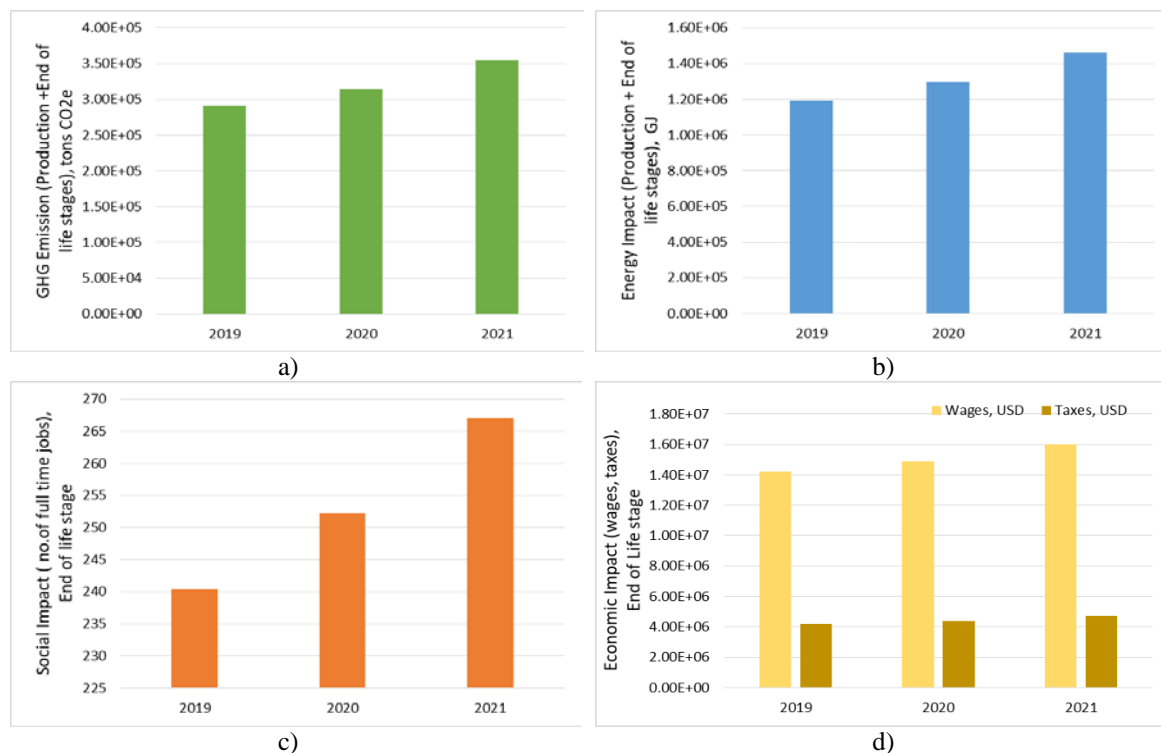


Figure 1. E-commerce waste management system impact assessment in Romania, over 2019-2021, a) Environmental impact expressed as total greenhouse gas emissions, b) Environmental impact as total energy impact, c) Social impact as number of full time jobs, d) Economic impact as wages and taxes

Although single use e-commerce packaging waste does not have a significant weight contribution to the total packaging waste stream, and it's composition consists of mainly recyclables such as cardboard and paper and plastic waste, the sustainability profile show that environmental impact has increased over the investigated period despite the efforts directed towards more sustainable packaging. Social and economic impacts have increased which means more jobs in the End of life treatment for this type of waste and more money into wages and taxes.

References:

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